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APPARATUS FOR SINGULATING FLAT ARTICLES

The invention relates to an apparatus for singulating flat articles according to the preamble of claim 1.

Flat articles, e.g. mail items, must be singulated from a stack e.g. in sorting systems. To ensure that only one article at a time is removed from the stack at the singulation or take-away station, there must be only minimal frictional force acting between the articles at singulation. For this reason the articles must be disposed upright on-edge, causing them to be in unstable equilibrium.

Large flexible articles often have only little intrinsic stability or have been carelessly stacked, so that they may collapse, slide off or tip over, resulting in undefined states with additional unwanted forces in the stack, thereby impeding singulation. If the stack pressure is increased, although the described processes are prevented, the higher stack pressure also results in increased friction between the articles, thereby again increasing the proportion of doubles.

To solve this problem the horizontal infeed plane has, according to EP 562 954 B1, just before the singulation/take-away station, a somewhat lower section onto which the leading flat articles drop down portionwise. Although some sticking between the articles is released in the process, they have a slight tilt which means that the friction between the articles cannot be minimized.

Also known is an apparatus for singulating flat articles (US 2002/0153654A1) in which a stack support holding the stack and an infeed conveyor on which the stack of articles stands are driven in a separately controlled manner. The stack support and conveyor are controlled as a function of the signals of two or more pressure sensors projecting one above the other from the take-away plane and which detect the stack orientation.

The object of the invention is to create a device for singulating flat, on-edge articles whereby even edge-mounted articles that are comparatively large and flexible and therefore unstable or that are inhomogeneous in terms of thickness can be singulated with low stack pressure without their tipping over or becoming deformed.

This object is achieved according to the invention by the features set forth in claim 1.

The detectors, as well as the conveyor and stack support which transport the articles in the stack in an upright manner to the take-away station and which are separately driven, can be individually moved horizontally in a controlled manner, in a plane perpendicular to the take-away reference plane. Depending on the ascertained position of the frontmost article, the drives of the detectors, of the conveyor and of the stack support are controllable in such a way that when the stack is transported to the take-away station the frontmost article is fed, supported by the detectors, upright and approximately parallel to the take-away reference plane, also supported by the detectors if the stack pressure measured by the detectors is low, to the take-away station, the detectors and associated actuators preventing the articles from becoming deformed and/or tipping over.

Advantageous embodiments of the invention are set forth in the sub-claims.

For example, it is advantageous if the control of the drives of the actuators, of the conveyor belt and of the stack support ensures the following sequence of operations:
- after take-away of an article, moving the detectors by means of the actuators out of the take-away reference plane in the direction of the in-fed stack until at least two detectors detect the now frontmost article in the stack,
- determining the position of the detected article and controlling the drives of the actuators, of the stack support and of the conveyor belt so that the end of the stack oriented

toward the take-away station is raised parallel to the take-away reference plane and is transported to the take-away station in the raised state, held between the detectors and the stack support, with low defined stack pressure at the detectors,

- shortly prior to take-away of the frontmost article, retracting of the detectors behind the take-away reference plane.

Among the articles in the stack, there are frequently large-format, flexible articles which, without lateral support, would collapse or become deformed in the upright position. In order to prevent this, advantageously so many detectors with their actuators are disposed at different heights that any bulging of the frontmost articles is detectable, which can then be eliminated by means of selective actuator control.

In order to loosen the stack and release any sticking together of the articles, jogging motions of the detectors with variable amplitude, frequency and force can be produced using drive control.

It is further advantageous for the stack support to be pivotally mounted on a linear guide, the pivoting axis being oriented horizontally, perpendicular to the take-away direction, and the pivoting mechanism being controllable in such a way that the frontmost articles of the stack viewed from the take-away station are fed in the desired upright orientation, thereby enabling the articles to be better aligned.

To ensure that the subsequent articles in the stack are supported even when the frontmost article is taken away, it is advantageous to provide, distributed over the length of the articles in the stack, a plurality of detectors disposed one above the other with their actuators which, as soon as the rear edge of the article being taken away has passed, are moved toward the stack.

To reduce the friction between detector and frontmost article there are advantageously located, at the tip of the detectors, friction reducing elements such as one or more sensing rollers rotatable in the take-away direction.

It is also advantageous if the detectors with the actuators each consist of linear motors with an integrated position measuring system, the motor current being used for force measurement. This provides a simple and inexpensive version.

If there are more stringent requirements in respect of force measuring accuracy, it is advantageous for the force to be determined not via the motor current but by mounting a force measuring device at the tip of the armature of the linear motor, it being advantageous to provide, as a force measuring device, a linearly displaceable and spring-biased ball which triggers a switching signal at a particular force.

The invention will now be described in greater detail in an exemplary embodiment with reference to the accompanying drawings in which:

FIG 1 shows a perspective schematic view of an apparatus for singulating flat articles with the stack in an unaligned state,

FIG 2 shows a perspective schematic view of an apparatus for singulating flat articles after stack alignment,

FIG 3 shows a perspective schematic view of the singulating apparatus with detectors and associated actuators disposed one behind the other in the take-away direction,

FIG 4 shows a side view of a linear motor as actuator for the detector,

FIG 5 shows a sectional view of the end of the linear motor armature with a force measuring device,

FIG 6 shows a side view of a singulating device with a tiltably guided stack support,

FIG 7 shows a plan view of a singulating device with a tiltably guided stack support,

FIG 8 shows a plan view of a singulating device having a detector with two sensing rollers.

Aligned to a lateral guide 26 on a horizontal loading plane 2 by synchronously running conveyor belts 3 and supported by a stack support 4 moved by means of a linear guide 5 and separate drive 6, the articles to be singulated 12 are fed to an underfloor belt 13 of the take-away mechanism in front of the take-away reference plane 10.
Behind the take-away reference plane 10 in which there are still disposed vertically oriented, driven conveyor belts as part of the take-away mechanism but which are not shown for the sake of clarity, there are mounted at an attachment point 11 at least two detectors with actuators 7,8 with detector function for determining the position of the frontmost item 1 and the stack pressure. These contain a linear control element, a position measuring device and a force measuring device. As the frontmost item 1 approaches the underfloor belt 13, the detectors with the actuators 7,8 measure the distance from the frontmost item 1 to the take-away reference plane 10, the deviation α of the frontmost article 1 from the optimum upright position and the force with which the article 1 presses against the detectors.

Depending on the tilt, the stack 12 is moved via the conveyor belts 3 or the drive 6 of the stack support 4 in such a way

that the front items stand precisely upright and the frontmost item 1 presses against the detectors with minimal force during singulation (FIG 2). In order to minimize friction in the supporting region, each detector is equipped with a plurality of sensing rollers 9.

To ensure that relatively large articles 1 are securely supported and the following articles in the stack 12 are held in position during the take-away process, two pairs of detectors with actuators 7A,8A and 7B,8B are provided in the take-away direction, the back pair 7A,8A in the conveying direction advancing to the following article and supporting it as soon as the back edge of the article 1 which is being taken away has left the vicinity of these detectors/actuators 7A,8A (FIG 3).

FIG 4 shows the implementation of a detector with its actuator as a linear motor 15. This comprises a stator 16 and a linear armature 17. The position of the armature head is determined by means of an integrated position measuring system 18 using Hall sensors. The forces emerging from the stack 12 and acting on the armature 17 obliquely to the armature axis are absorbed by guide elements disposed parallel to the motor axis. The forces in the armature axis can be determined via the motor current. If the force measurement is to be very fine, the head of the armature 17 is equipped with a special force measuring device. In most cases it is sufficient if a switching signal is triggered for a defined small force. This can be achieved by means of a displaceable ball 23 which is biased by spring 24 and which triggers the switching signal in a sensor 20 in response to the particular force and therefore a particular travel. The switching signal can be electrically, magnetically, optically or pneumatically generated.

This is shown schematically in FIG 5. The armature 17 of the linear motor 15 possesses at its free end a bore 19 to accommodate the sensor 20 and an external thread 21 for adjustably mounting the sensing head 22 with the measuring

ball 23 and the spring 24 for biasing.

FIG 6 shows a stack 12 of flat articles transported to the take-away station using the conveyor belts 3 and the stack support 4. In addition to the two positioning axes already shown in FIG 1 for driven conveyor belts 3 and linear guide 5 with linear drive 6 for the stack support 4, the stack support 4 is, as shown, actively pivotally mounted on the linear guide 5 by means of pivoting mechanism 25. This makes it possible, when the stack 12 is inclined backward as shown and the frontmost article 1 has reached the end of the conveyor belt 3, to align the stack 12 when the conveyor belt 3 is at a standstill by advancing the stack support 4 in the direction of the take-away reference plane 10 while simultaneously pivoting the stack support 4 forward.
Here there is additionally disposed between the upper and the lower actuator 7,8 a third actuator 14 with which it is possible in the case of flexible, bulging articles to counteract this bulging.

The plan view (FIG 7) shows the stack 12 in the aligned state. The stack support 4 has been pivoted into the upright position. At the take-away station, the articles aligned to the lateral guide 26 are fed onto the underfloor take-away belt 13 and are propelled as far as the take-away reference plane 10 where vertically oriented, driven conveyor belts 27 take the articles away in synchronism with the underfloor take-away belt 13 into the singulating apparatus (direction of arrow). The rotating or pivoting drive 25 of the stack support 4 is also clearly shown.

FIG 8 shows an actuator/linear motor with two sensing rollers 9 and two linear guides 28 for the sensing rollers 9, force measurement being incorporated in the roller bar 29.